

Impact of resolution increase for seasonal forecast quality in EC-Earth

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P. Davini, F. Doblas-Reyes

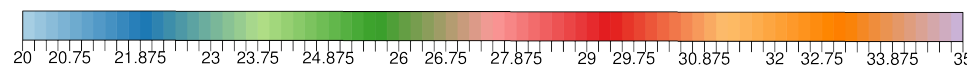
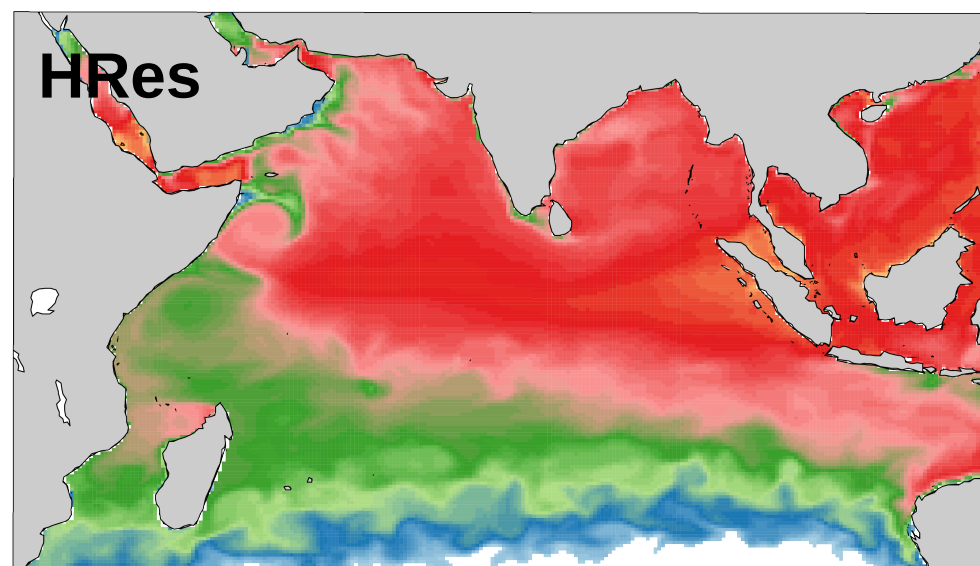
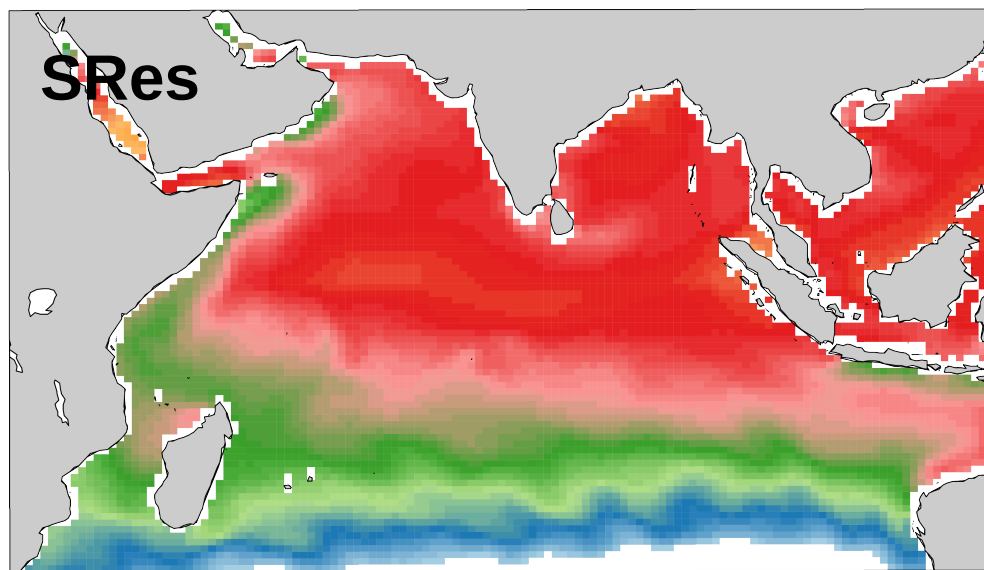
EC-Earth meeting, Reading, 06/05/2015



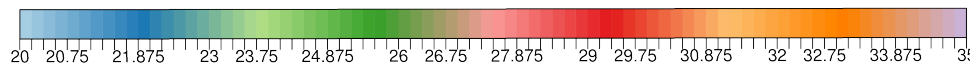
Introduction

Past studies have shown that an increased resolution improves different aspects of the simulation from small scale to global and from intra-daily to decadal.

Few studies on the impact of increasing resolution on seasonal forecast quality.

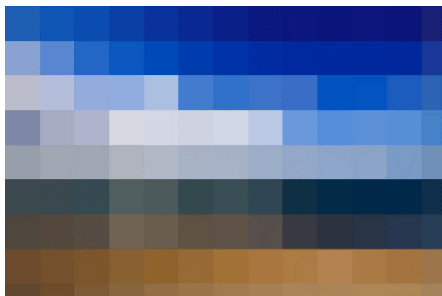


Seasonal forecasting is also a good way to test EC-Earth at high resolution because seasonal forecasts are parallelized “naturally”.

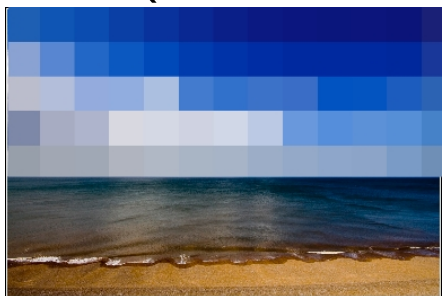


Experimental design

SRes (T255/ORCA1)



IRes (T255/ORCA025)

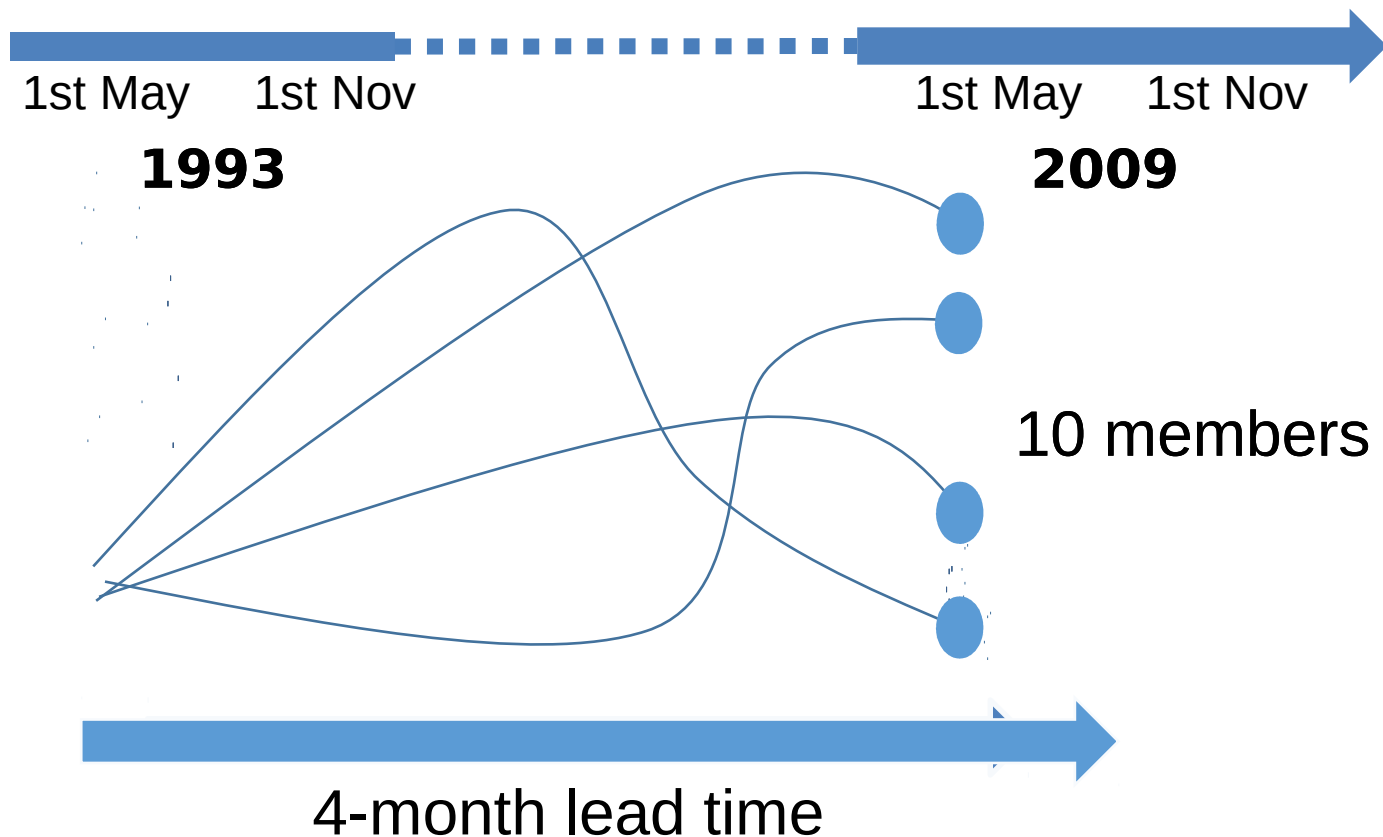


HRes (T511/ORCA025)



Seasonal retrospective hindcasts
performed with **EC-Earth 3.0.1**

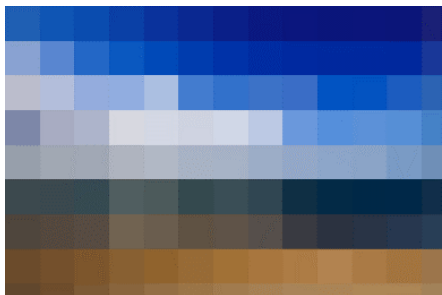
34 start dates: May and November
every year between 1993 and 2009



Numbers and reminder for fair comparison

SRes (T255/ORCA1)

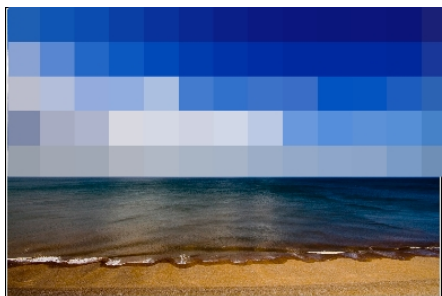
1° - 70km



CPU/month/member: 75

IRes (T255/ORCA025)

0.25° - 70km



CPU/month/member: 493

HRes (T511/ORCA025)

0.25° - 40km



CPU/month/member: 2256

x 6

x 4

- The initialization product (GLORYS) is performed at high resolution so the IC have been interpolated.

- SRes had more tuning than IRes and HRes.

- Less tuning had been performed at these resolutions

- Only vertical interpolation for the IC.
- Eddy permitting
- Better coupling (thicker ML)
- Bathymetry

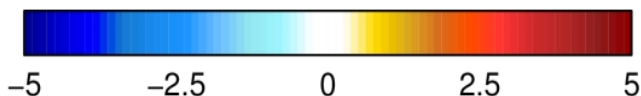
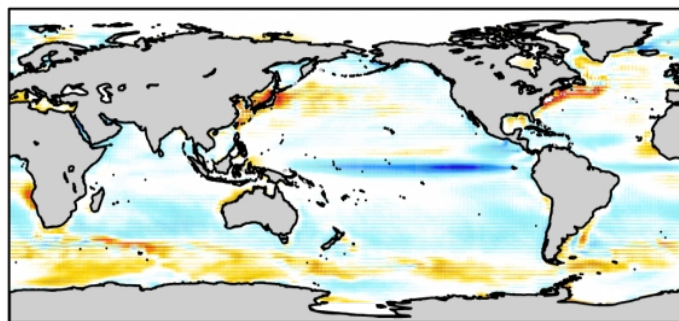
- Better orography...

Impact on the mean climate

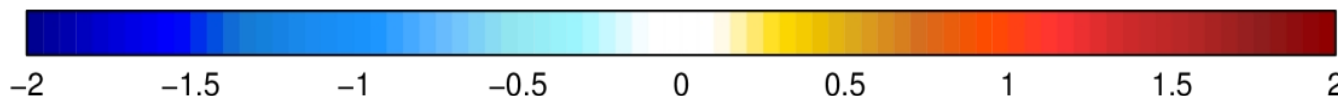
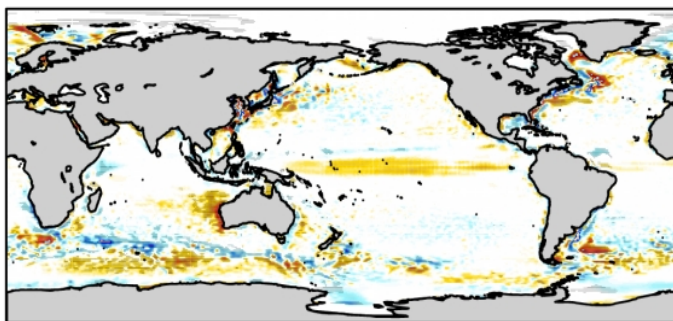
*November start dates:
DJF (1 month lead time)*

SST

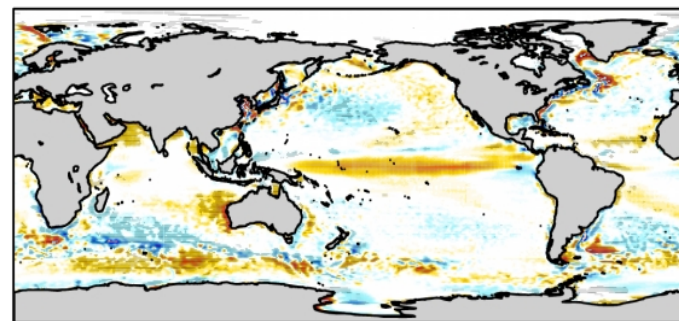
SRes - ERSST



IRes - SRes



HRes - SRes

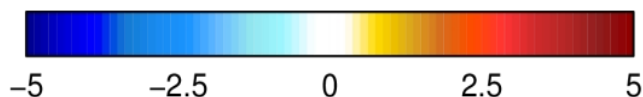
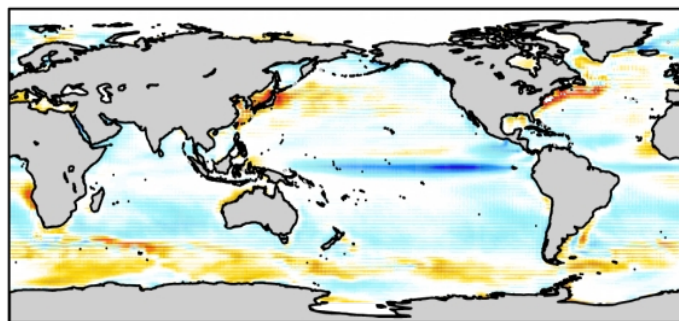


Impact on the mean climate

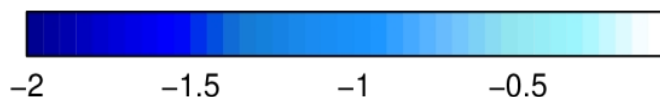
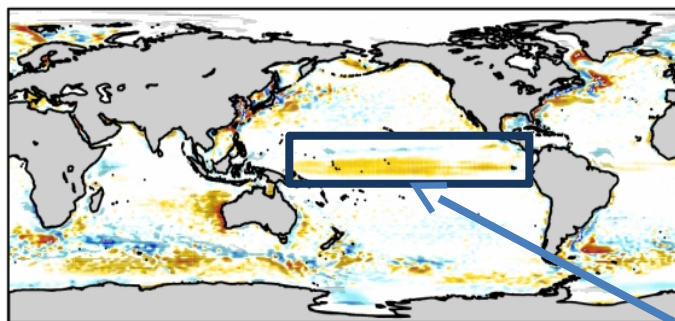
*November start dates:
DJF (1 month lead time)*

SST

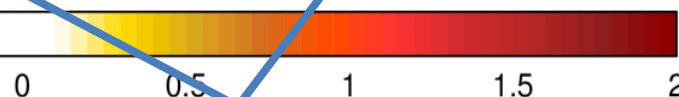
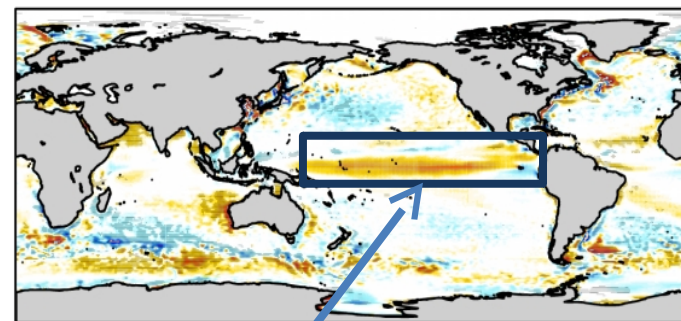
SRes - ERSST



IRes - SRes



HRes - SRes



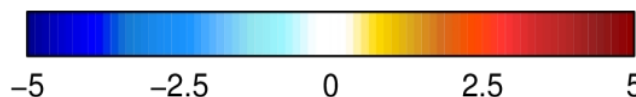
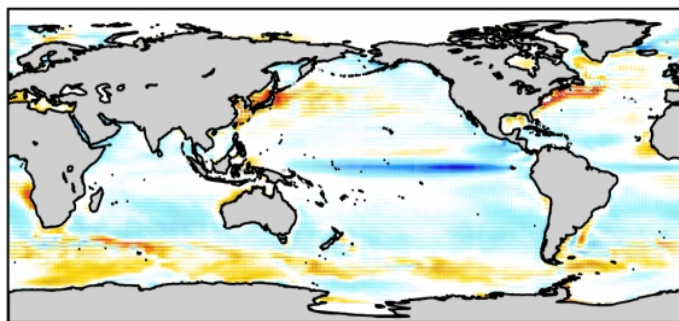
Improvement of the cold tongue bias
(stronger in HRes)

Impact on the mean climate

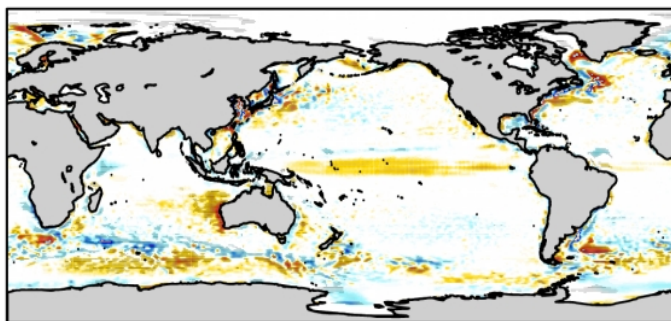
*November start dates:
DJF (1 month lead time)*

SST

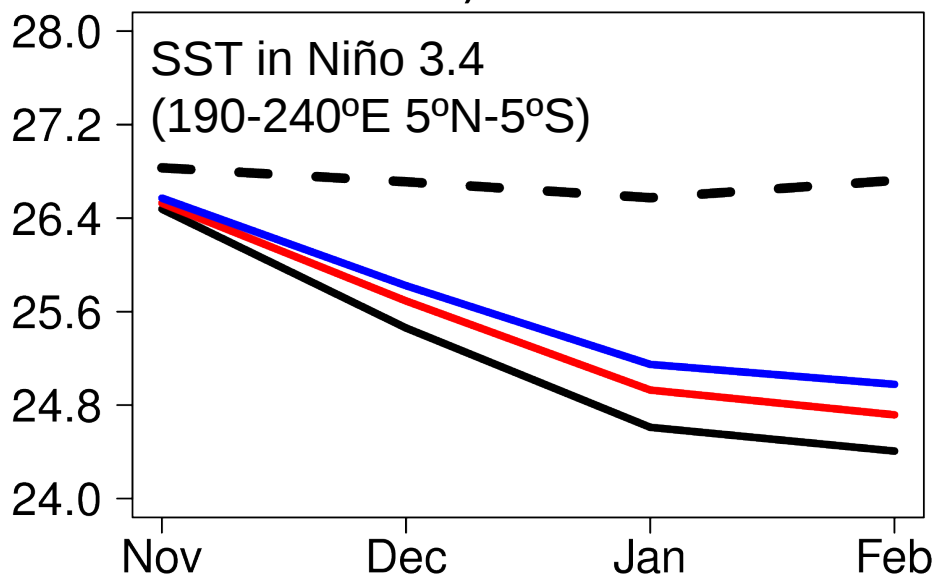
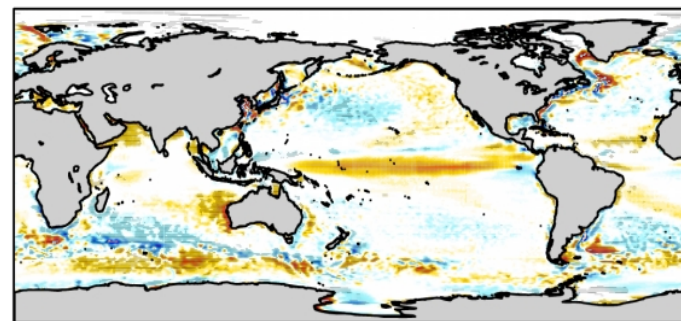
SRes - ERSST



IRes - SRes



HRes - SRes

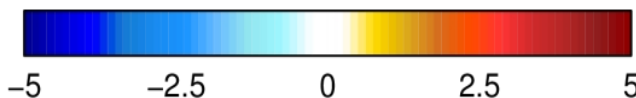
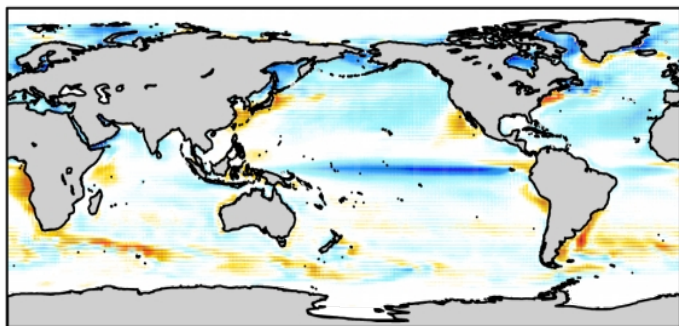


Impact on the mean climate

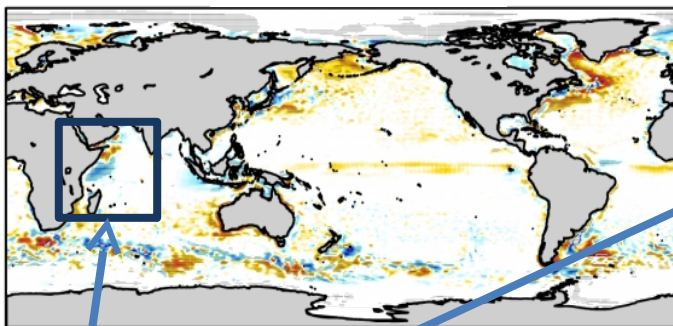
SST

*May start dates:
JJA (1 month lead time)*

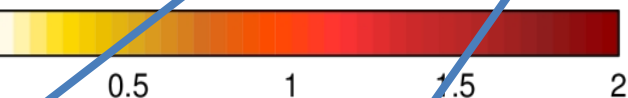
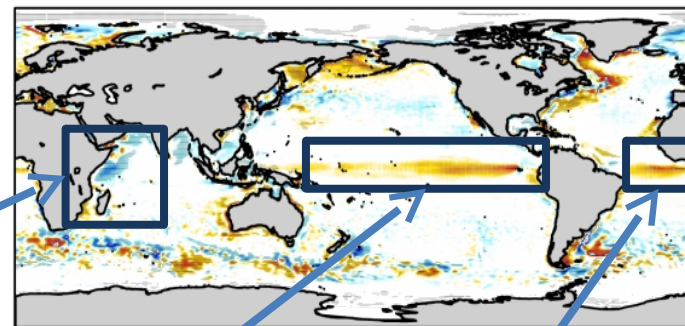
SRes - ERSST



IRes - SRes



HRes - SRes



Improvement of the Somalian Upwelling

Improvement of
the cold tongue
bias.

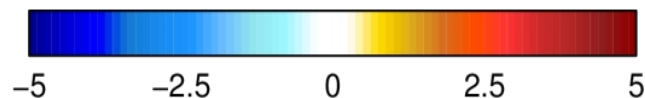
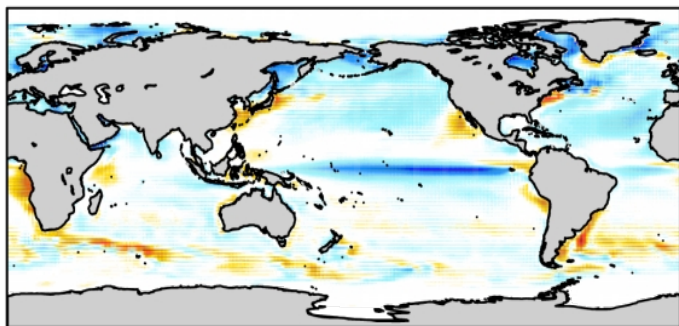
Improvement in the
equatorial Atlantic
bias.

Impact on the mean climate

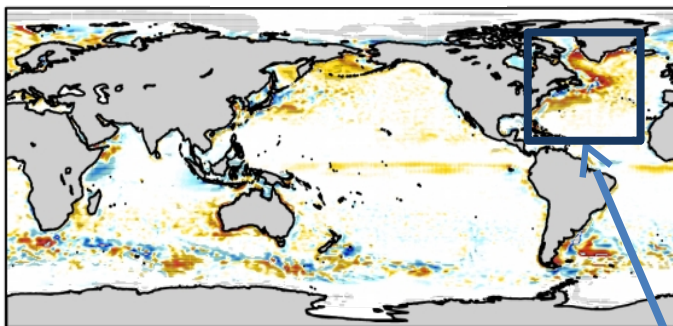
SST

*May start dates:
JJA (1 month lead time)*

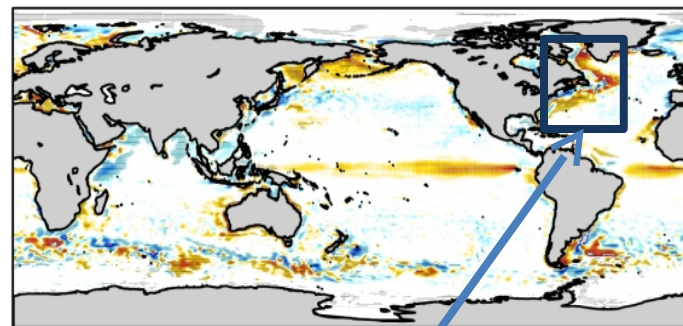
SRes - ERSST



IRes - SRes



HRes - SRes



Reduction of the cold bias
in the Northern
Hemisphere

Impact on the mean climate

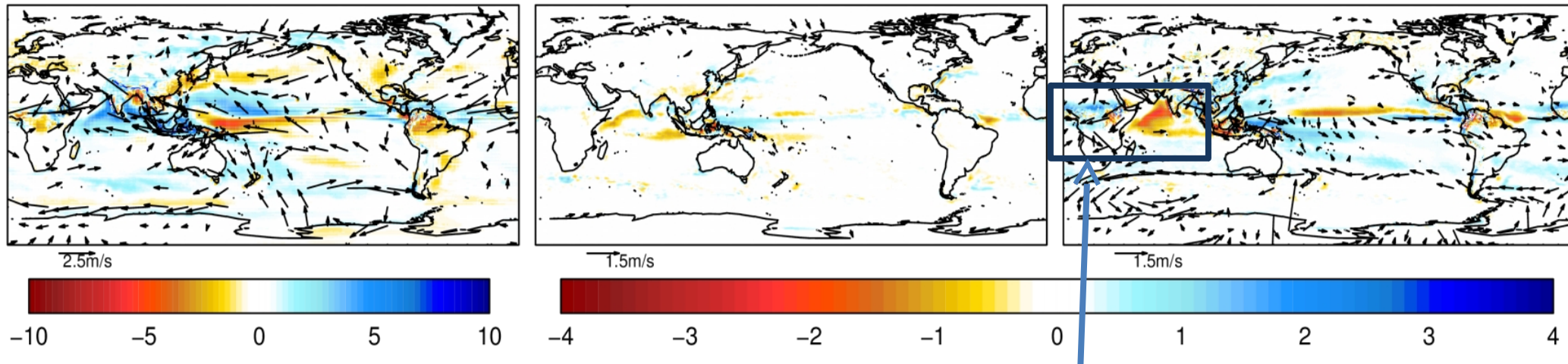
*May start dates:
JJA (1 month lead time)*

Precipitation – wind at 850hPa

SRes - Observation

IRes - SRes

HRes - SRes



Change in the African and Indian monsoon

Impact on the mean climate

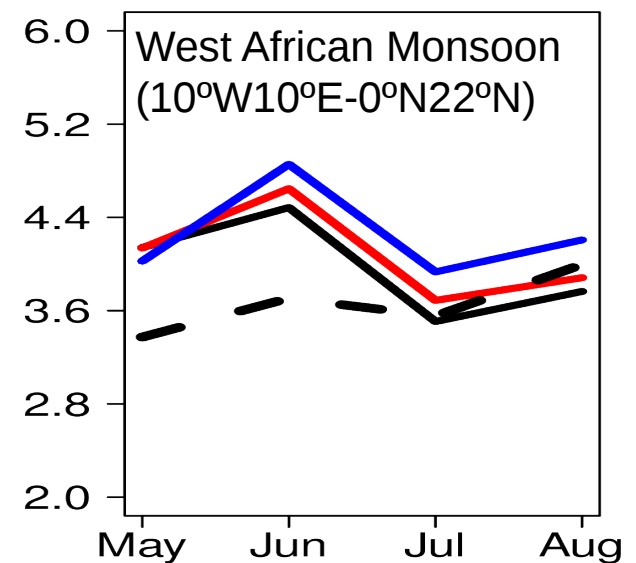
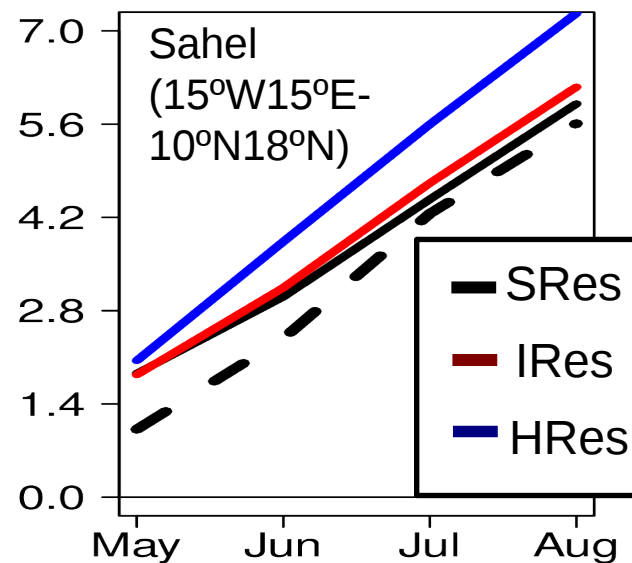
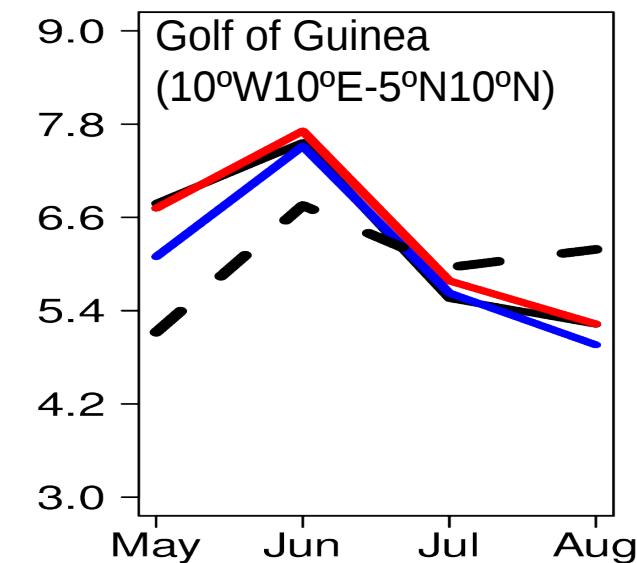
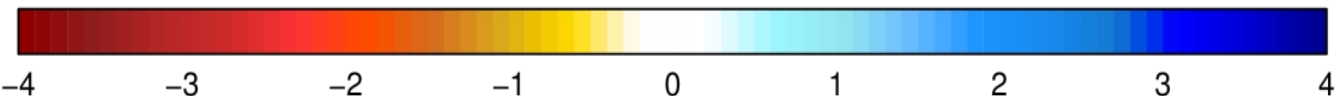
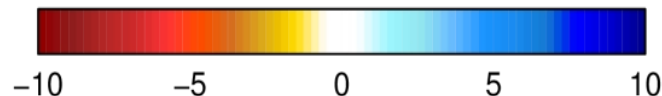
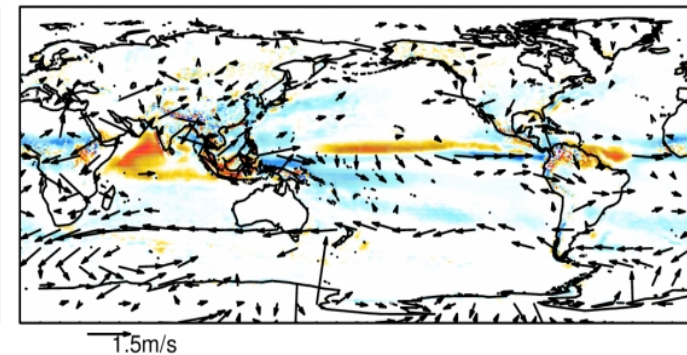
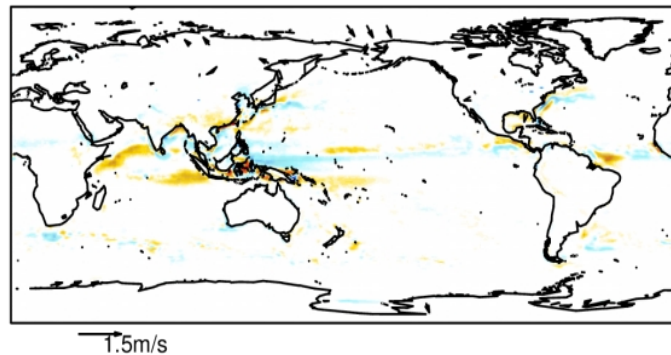
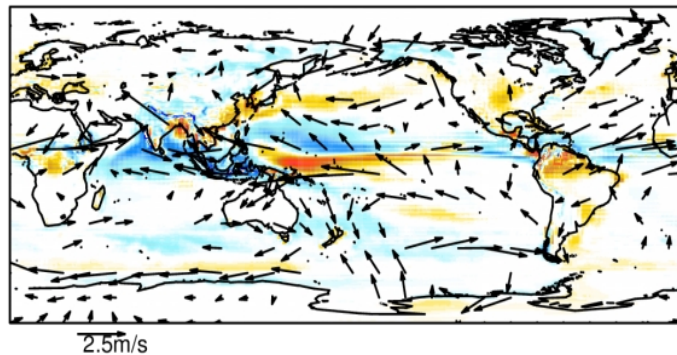
*May start dates:
JJA (1 month lead time)*

Precipitation – wind at 850hPa

SRes - Observation

IRes - SRes

HRes - SRes



Impact on the mean climate

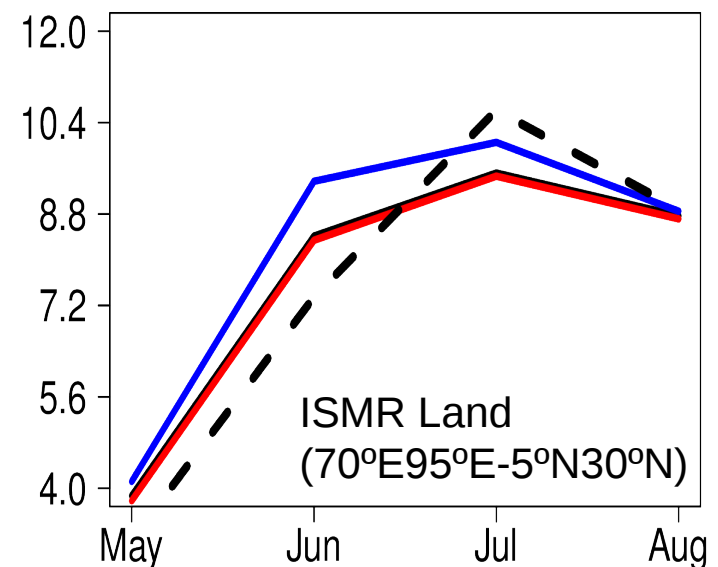
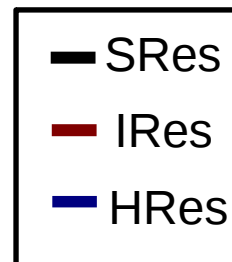
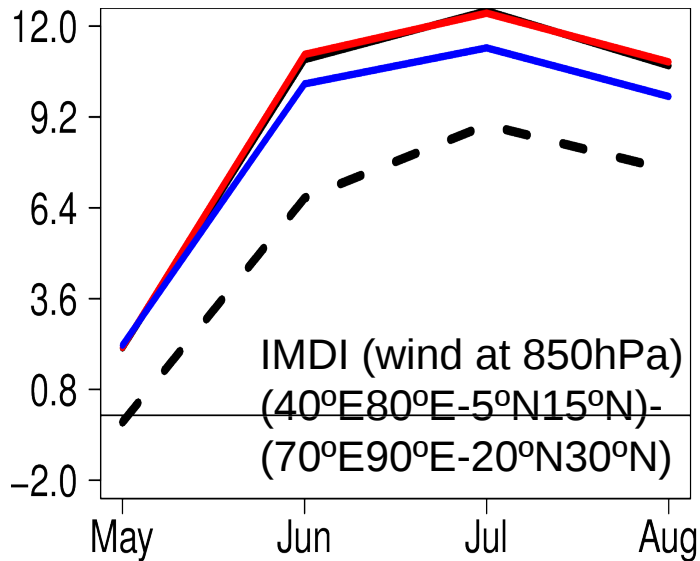
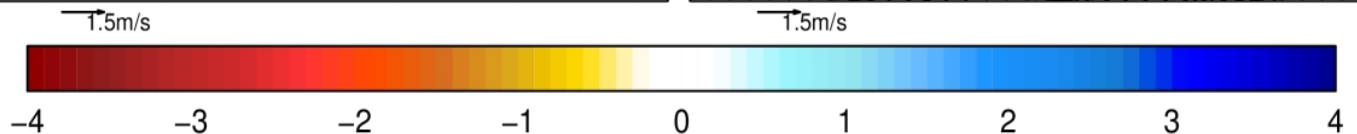
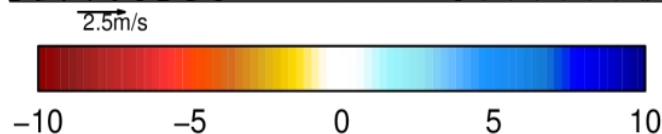
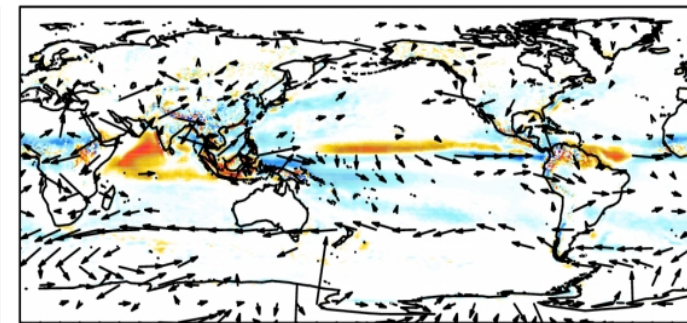
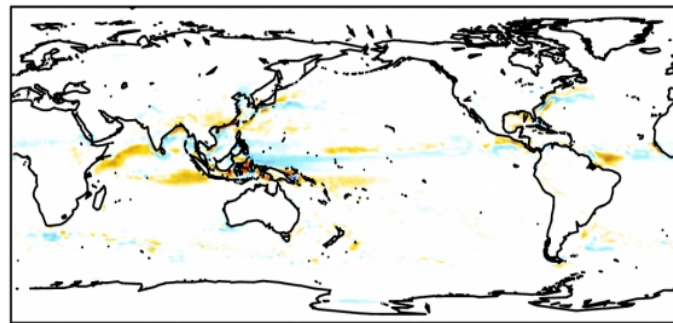
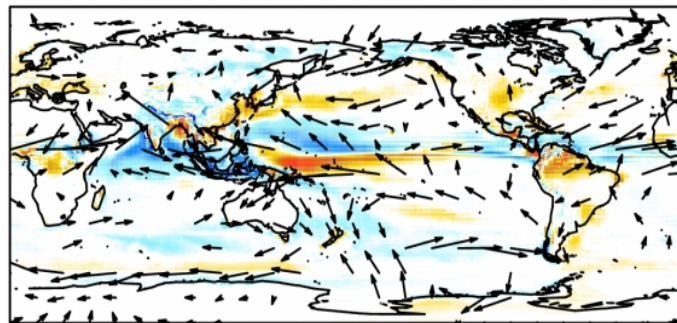
*May start dates:
JJA (1 month lead time)*

Precipitation – wind at 850hPa

SRes - Observation

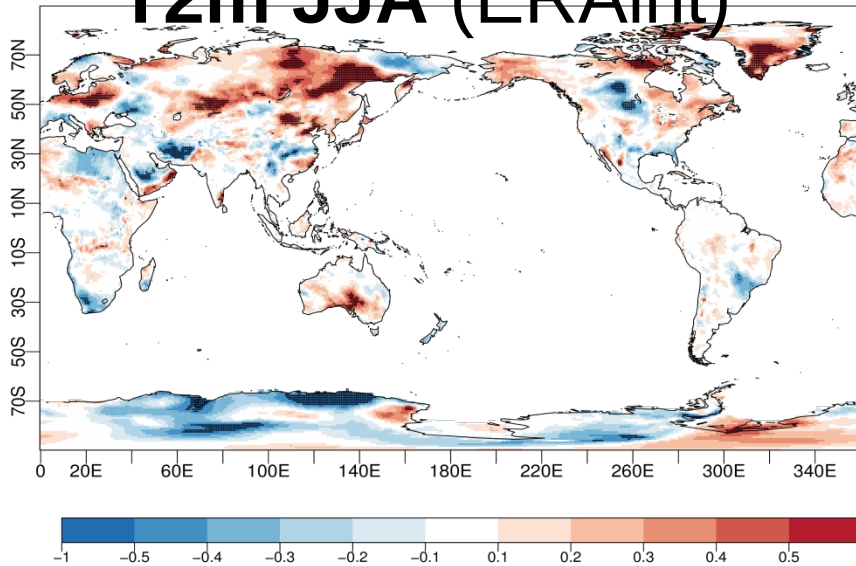
IRes - SRes

HRes - SRes

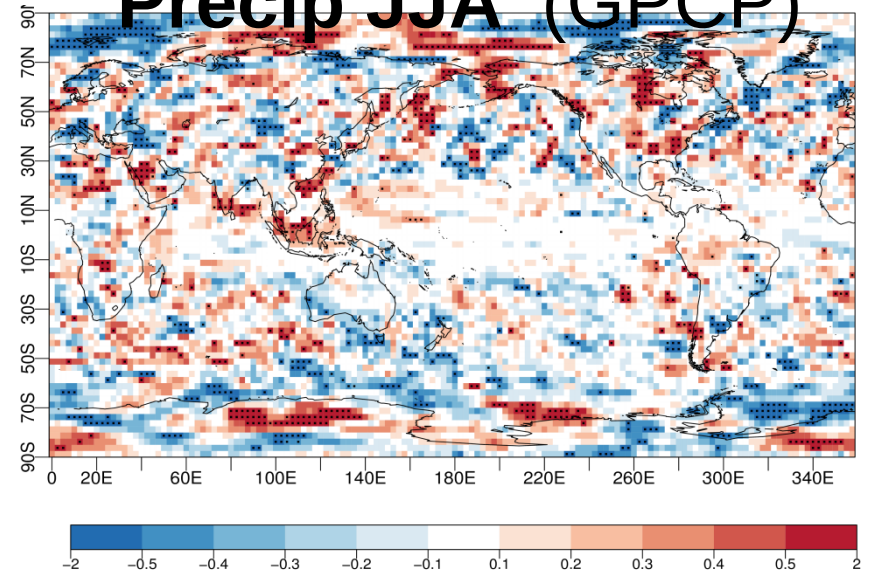


Impact on skill: Correlation HRes-SRes

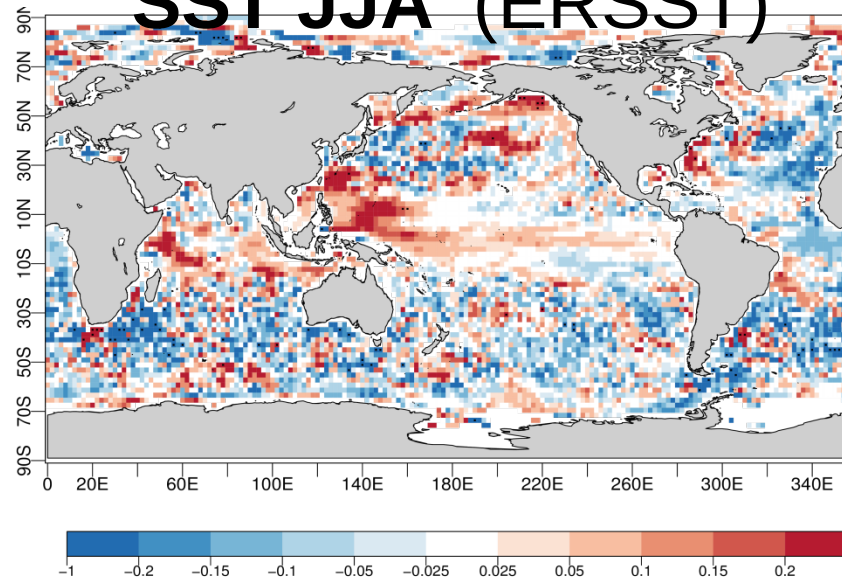
T2m JJA (ERAint)



Precip JJA (GPCP)



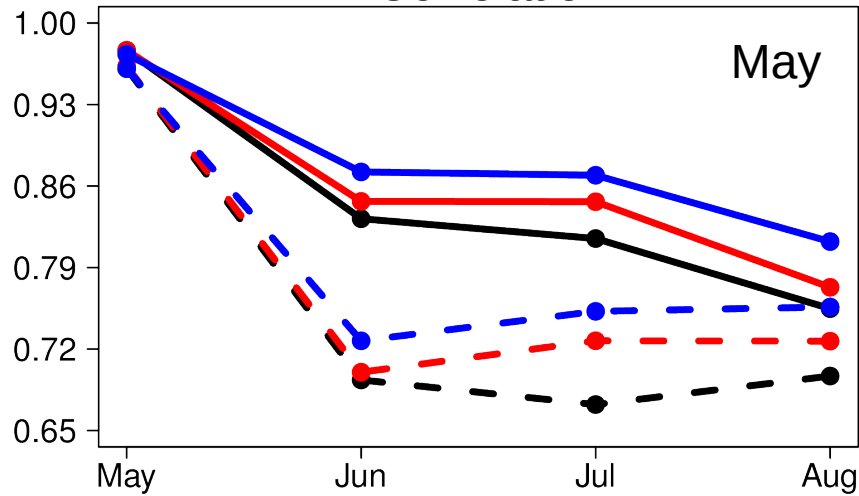
SST JJA (ERSST)



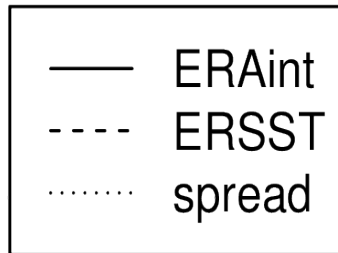
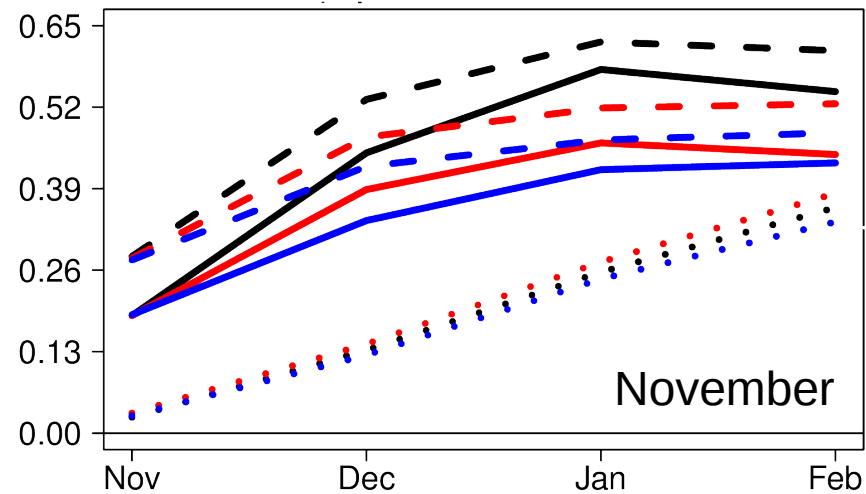
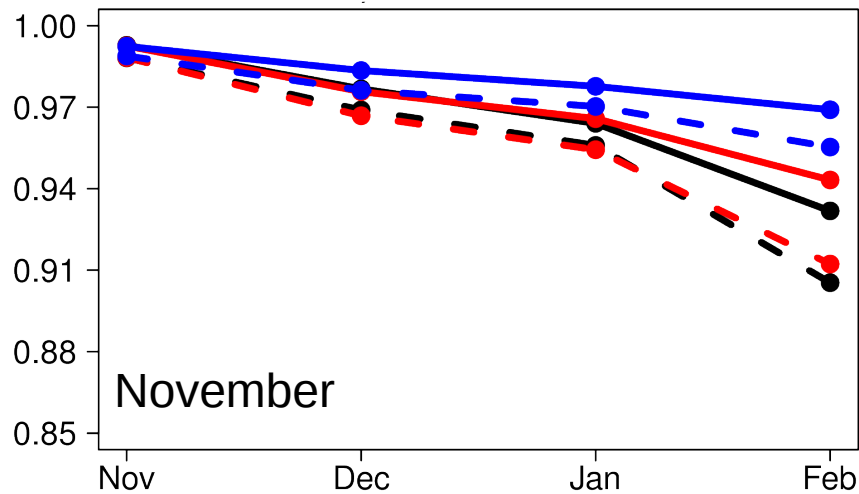
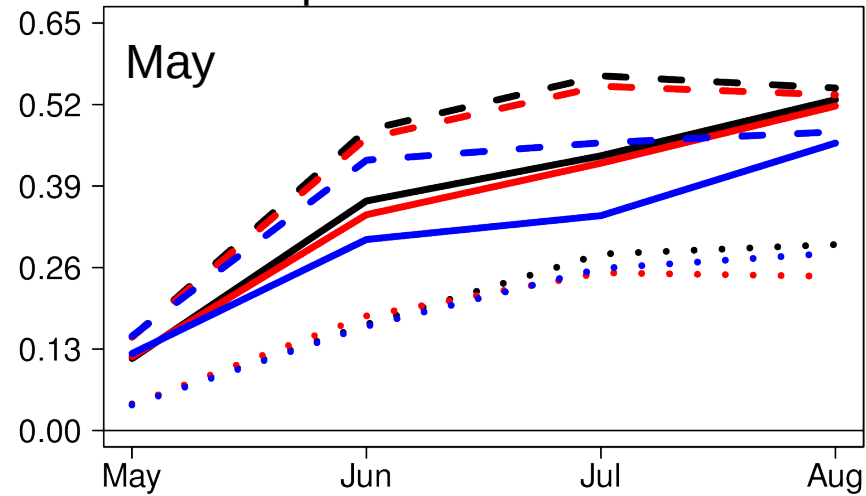
Forecast initialized in
May
1 month lead time

Impact on skill: Niño 3.4

Correlation

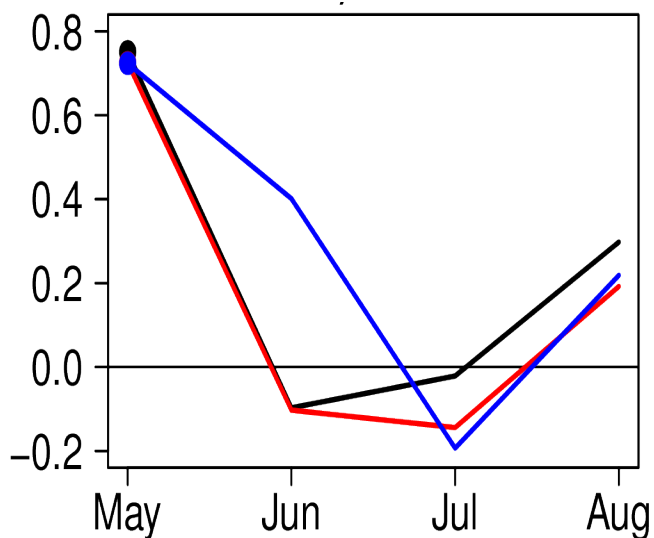


Spread and RMSE

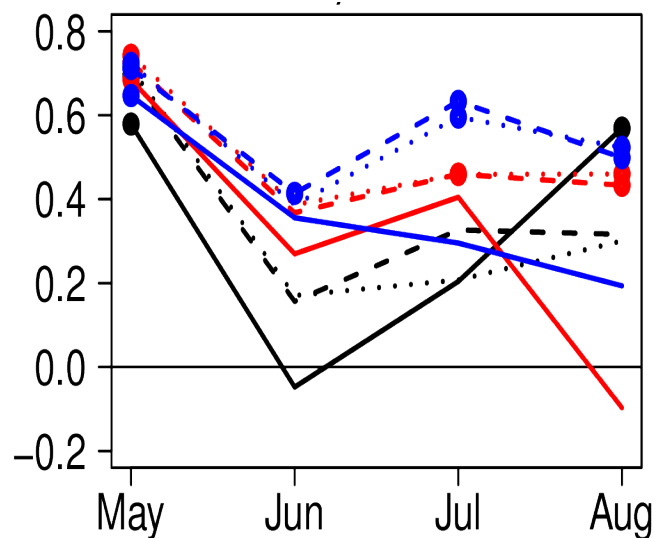


Impact on skill: Indian Monsoon

Correlation: IMDI



Correlation: ISMR



— SRes
— IRes
— HRes

— ERA-Interim
- - GPCP
..... GPCC

Onset date Correlation:

SRes: 0.57

IRes: 0.62

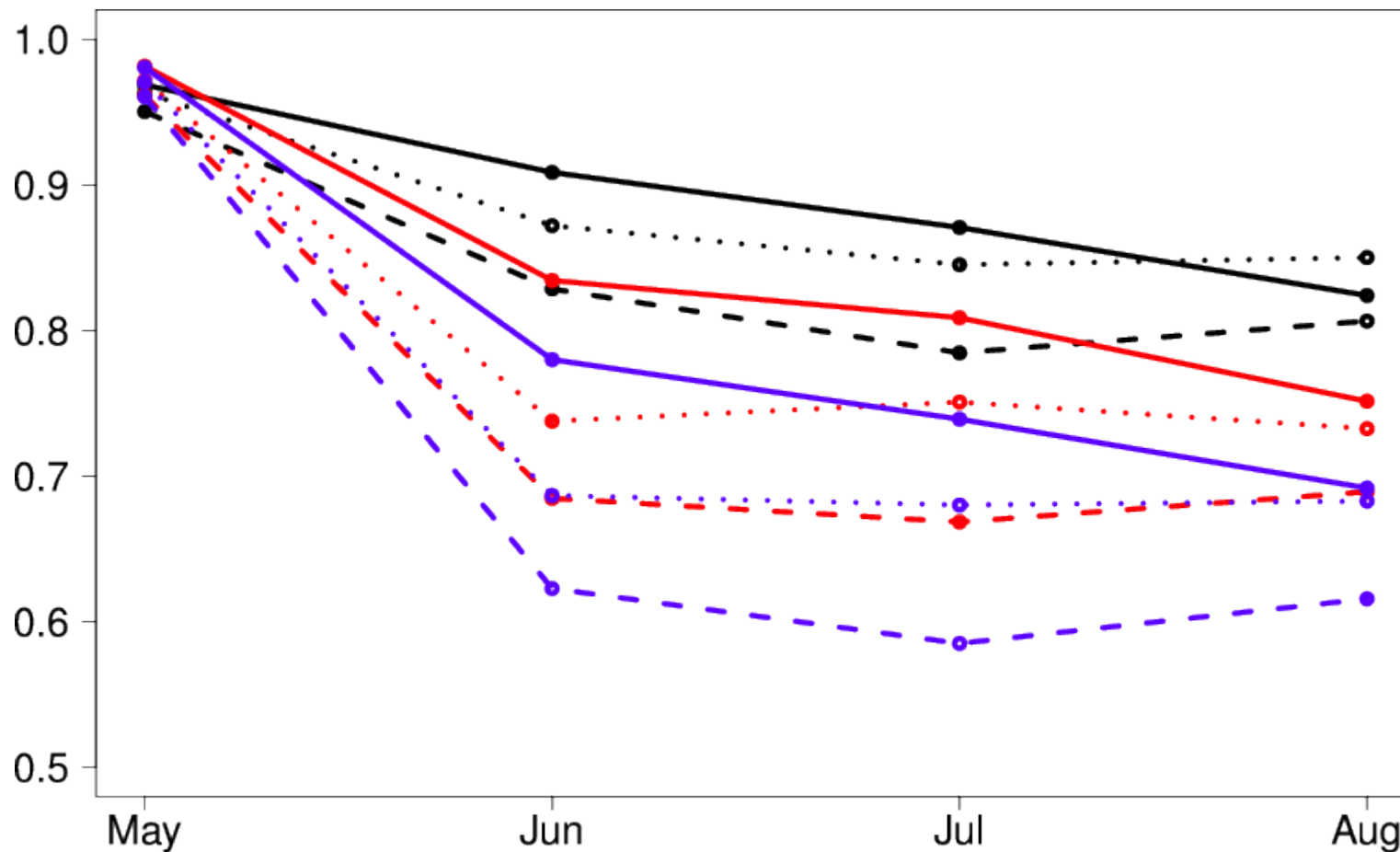
HRes: 0.63

Summary and Conclusion

- Increase of both oceanic and atmospheric resolution slightly improves the representation of the mean state.
 - Grid-point skill improvements are sparse and noisy.
 - The skill of ENSO and of the early stages of the Indian monsoon is improved when the resolution is increased.
 - Other improvements not presented in details here:
 - Skill of NAO
 - Amplitude and skill of winter frequency of atmospheric blocking
 - Skill of sea ice extent
- **The increase of resolution do not lead to any spectacular improvements but to an addition of small improvements.**
- Additional work needs to be done on tuning of high resolution simulations, testing new initial conditions, method to compare experimental different resolutions, high resolution data for quality assessment

Additional remark

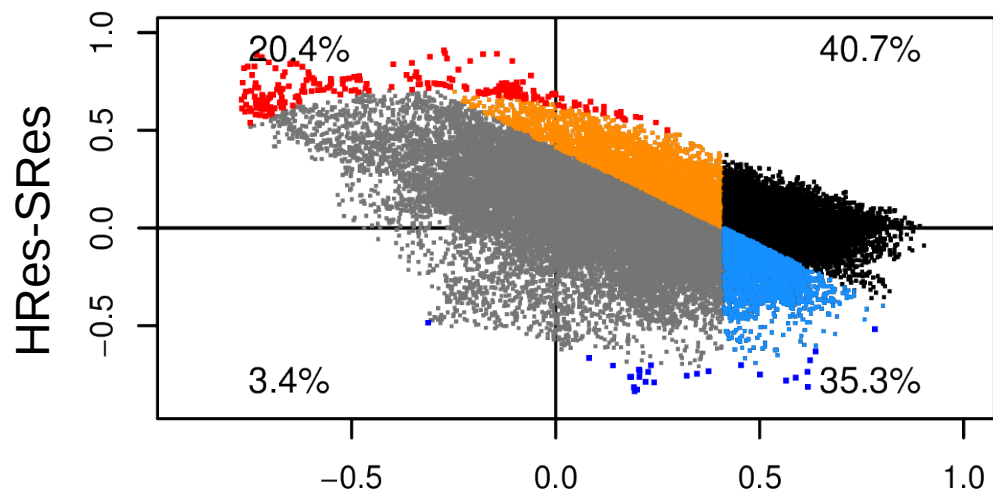
Correlation in Niño 3.4



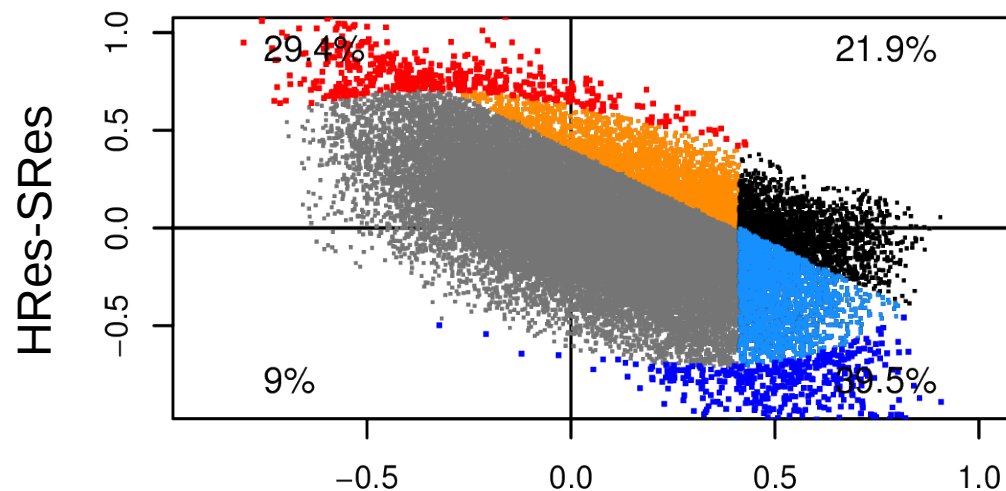
May start dates
1993-2009

Impact on skill

T2m over land JJA

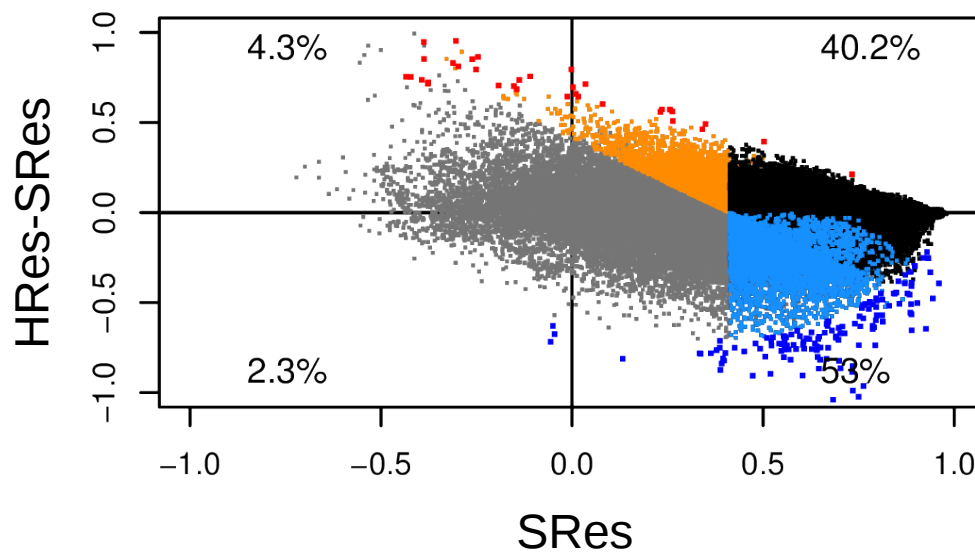


Precip over land JJA



SRes

SST JJA



SRes

What is the influence of the interpolation?